CLAIM AMENDMENTS

The claims are amended as follows:

Claims 1-23 (Cancelled).

24. (Previously presented) An optical identification element for identifying an item, comprising:

a substrate, at least a portion of said substrate being made of a substantially single material and having at least one diffraction grating embedded therein, said grating having a resultant refractive variation within the substantially single material at a grating location;

said grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating from outside the substrate, said output signal being a result of passive, non-resonant scattering from said grating when illuminated by said incident light signal; and

the element being at least partially disposed on the item.

25. (previously presented) The apparatus of claim 24 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

26. (previously presented) The apparatus of claim 24 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

27. (previously presented) The apparatus of claim 24 wherein said substrate is made of a material selected from the group: glass, silica, plastic, rubber, and polymer.

28. (previously presented) The apparatus of claim 24 wherein said code comprises a plurality of digital bits.

29. (previously presented) The apparatus of claim 24 wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 28, 30, 40, 50, or 100.

30. (previously presented) The apparatus of claim 24 wherein said code comprises a plurality of bits, each bit having a plurality of states.

31. (previously presented) The apparatus of claim 24 wherein said code comprises a plurality of bits, each bit having a corresponding spatial location in said optical output signal and each bit in said code having a value related to the intensity of said output optical signal at the spatial location of each bit.

32. (previously presented) The apparatus of claim 31 wherein the value of said intensity is related to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

33. (previously presented) The apparatus of claim 24 wherein said code comprises a plurality of digital bits, each bit having a corresponding spatial location in said optical output signal and each bit in said code having a binary value related to the intensity of said output optical signal at the spatial location of each bit.

34. (currently amended) The apparatus of claim 33 wherein the value of <u>each bit</u> ~~said intensity~~ is related to the presence or absence of a corresponding refractive index pitch in said grating.

35. (previously presented) The apparatus of claim 24 wherein said incident light comprises a single wavelength.

36. (previously presented) The apparatus of claim 24 wherein said incident light comprises a plurality of wavelengths or a single wavelength scanned over a predetermined wavelength range.

37. (previously presented) The apparatus of claim 36 wherein said code comprises a plurality of bits, and each bit in said code having a value related to the intensity of said output optical signal at a wavelength corresponding to each bit.

38. (previously presented) The apparatus of claim 37 wherein the value of said intensity is related to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

39. (previously presented) The apparatus of claim 36 wherein said code comprises a plurality of digital bits, and each bit in said code having a binary value related to the intensity of said output optical signal at the wavelength corresponding to each bit.

40. (currently amended) The apparatus of claim 39 wherein the value of each bit ~~said intensity~~ is related to the presence or absence of a corresponding refractive index pitch in said grating.

41. (previously presented) The apparatus of claim 24 wherein said substrate has a length that is less than about 1000 microns.

42. (previously presented) The apparatus of claim 24 wherein said substrate has a diameter that is less than about 1000 microns.

43. (previously presented) The apparatus of claim 24 wherein said substrate has a reflective coating disposed thereon.

44. (previously presented) The apparatus of claim 24 wherein said substrate has a coating disposed on at least a portion of said substrate, at least a portion of said coating being made of a material that allows sufficient amount of said incident light signal to pass through said material to allow detection of said code.

45. (previously presented) The apparatus of claim 24 wherein said substrate has a coating material disposed on at least a portion of said substrate, said coating comprising a polymer.

46. (previously presented) The apparatus of claim 24 wherein said substrate has a magnetic or electric charge polarization.

47. (previously presented) The apparatus of claim 24 wherein said substrate has geometry having holes therein or having protruding sections therein.

48. (previously presented) The apparatus of claim 24 wherein at least a portion of said substrate has an end cross sectional geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

49. (previously presented) The apparatus of claim 24 wherein at least a portion of said substrate has a side view geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

50. (previously presented) The apparatus of claim 24 wherein at least a portion of said substrate has a 3-D shape selected from the group: a cylinder, a sphere, a cube, and a pyramid.

51. (previously presented) The apparatus of claim 24 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said substrate has a plurality of grating regions.

52. (previously presented) The apparatus of claim 24 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is greater than that of said non-grating region.

53. (previously presented) The apparatus of claim 24 wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is not greater than that of said non-grating region.

54. (previously presented) The apparatus of claim 24 wherein said incident light is incident on said substrate along a longitudinal grating axis of said grating.

55. (previously presented) The apparatus of claim 24 wherein said incident light is incident on said substrate at an angle to a longitudinal grating axis of said grating.

56. (previously presented) The apparatus of claim 24 wherein said incident light comprises laser light.

57. (previously presented) The apparatus of claim 24 wherein said grating comprises a thin grating or a blazed grating.

58. (previously presented) The apparatus of claim 24 wherein said substrate comprises a plurality of said gratings.

59. (previously presented) The apparatus of claim 24 wherein said substrate comprises a plurality of said gratings each at different locations within said substrate.

60. (previously presented) The apparatus of claim 24 wherein said substrate comprises a particle or bead.

61. (previously presented) The apparatus of claim 24 wherein at least a portion of said substrate is disposed on an outer surface of the item.

62. (previously presented) The apparatus of claim 24 wherein said substrate is disposed within said item and said item is made of a material that allows said code to be detected from output signal.

63. (previously presented) The apparatus of claim 24, where the item is selected from the group, comprising: large or small objects, products, solids, powders, liquids, gases, plants, currency, ID cards, minerals, cells and/or animals.

64. (previously presented) The apparatus of claim 24, where said code comprises a digital code indicative of information relating to: identity, type of item, lot number, manufacturer, serial number, date code, or code error checking.

65. (previously presented) An item having an optical identification element disposed therein, comprising:

a substrate, at least a portion of said substrate being made of a substantially single material and having at least one diffraction grating embedded therein, said grating having a resultant refractive index variation with the substantially single material at a grating location;

said grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating from outside the substrate, said code identifying at least one of the element and said item, said output signal being a result of

passive, non-resonant scattering from said grating when illuminated by said incident light signal; and

said code identifying the item.

66. (previously presented) The apparatus of claim 65 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

67. (previously presented) The apparatus of claim 65 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

68. (previously presented) The apparatus of claim 65 wherein said substrate comprises a particle or bead.

69. (previously presented) The apparatus of claim 65, where the item is selected from the group, comprising: large or small objects, products, solids, powders, liquids, gases, plants, currency, ID cards, minerals, cells and/or animals.

70. (previously presented) The apparatus of claim 65, where said code comprises a digital code indicative of information relating to: identity, type of item, lot number, manufacturer, serial number, date code, or code error checking.

71. (previously presented) A method of reading a code associated with an optical identification element that is disposed on an item, the element having a substrate, at least a portion of said substrate being made of a substantially single material and having a diffraction grating embedded therein, said grating having a resultant refractive index variation within the substantially single material at a grating location, comprising:

illuminating said element with incident light propagating from outside the substrate, said grating providing an output light signal indicative of the code, said output signal being a result of passive, non-resonant scattering from said grating when illuminated by said incident light signal; and

reading said output light signal and detecting said code therefrom.

72. (previously presented) The method of claim 71 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

73. (previously presented) The method of claim 71 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

74. (previously presented) The method of claim 71 wherein said element comprises a particle or bead.

75. (previously presented) The method of claim 71, where the item is selected from the group, comprising: large or small objects, products, solids, powders, liquids, gases, plants, currency, ID cards, minerals, cells and/or animals.

76. (previously presented) The method of claim 71, where said code comprises a digital code indicative of information relating to: identity, type of item, lot number, manufacturer, serial number, date code, or code error checking.

77. (previously presented) A method for labeling an item, comprising:

obtaining a substrate having at least a portion thereof being made of a substantially single material and having at least one diffraction grating embedded therein, said grating having a resultant refractive variation with the substantially single

material at a grating location, said grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating from outside the substrate, said output signal being a result of passive, non-resonant scattering from said grating when illuminated by said incident light signal; and

said substrate being at least partially disposed on the item.

78. (previously presented) The method of claim 77 wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.

79. (previously presented) The apparatus of claim 77 wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.

80. (previously presented) The method of claim 77 wherein said substrate is disposed within said item.

81. (previously presented) The method of claim 77 wherein said substrate comprises a particle or bead.

82. (previously presented) The method of claim 77, where the item is selected from the group, comprising: large or small objects, products, solids, powders, liquids, gases, plants, currency, ID cards, minerals, cells and/or animals.

83. (previously presented) The method of claim 77, where said code comprises a digital code indicative of information relating to: identity, type of item, lot number, manufacturer, serial number, date code, or code error checking.

84. (previously presented) The optical identification element of claim 24, wherein said code identifying at least one of the element and said item.

85. (previously presented) The item of claim 24, wherein said code identifying at least one of the element and said item.

86. (previously presented) The method of claim 71, wherein said code identifying at least one of the element and said item.

87. (previously presented) The method of claim 77, wherein said code identifying at least one of the element and said item.